SD
11
.A7995

443
C

Report No. 68-1-4

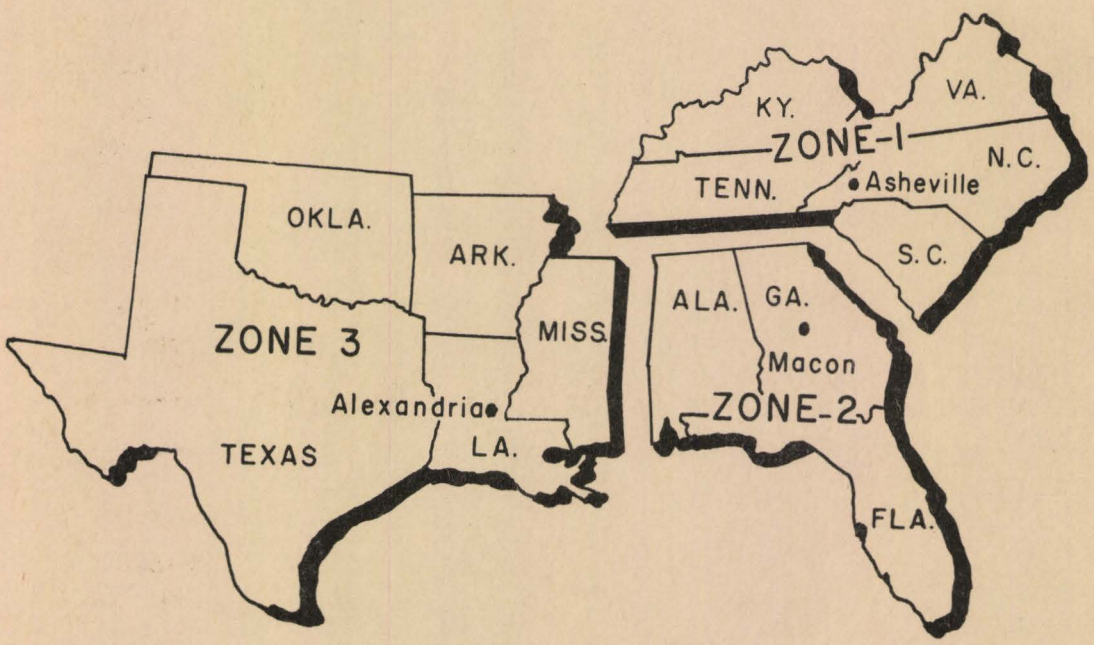
July 1967

3400

INCIDENCE OF COMANDRA BLISTER RUST ON THE CUMBERLAND PLATEAU IN EASTERN TENNESSEE - 1967

By

C. E. Cordell and J. L. Knighten
U. S. Forest Service, Asheville, N. C.
and
Ralph B. Quillin
Tennessee Division of Forestry
Knoxville, Tennessee



U. S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE
SOUTHEASTERN AREA, STATE AND PRIVATE FORESTRY
DIVISION OF FOREST PEST CONTROL

Report No. 68-1-4

July 1967

3400

INCIDENCE OF COMANDRA BLISTER RUST ON THE CUMBERLAND PLATEAU IN EASTERN TENNESSEE - 1967

By

C. E. Cordell and J. L. Knighten
U. S. Forest Service, Asheville, N. C.
and
Ralph B. Quillin
Tennessee Division of Forestry
Knoxville, Tennessee

ABSTRACT

In May, 1967, a cooperative comandra rust survey was made throughout the Cumberland Plateau by the Division of Forest Pest Control and the Tennessee Division of Forestry. The results of this survey revealed the disease presence in four counties south of Highway 70 on the Plateau. Forty percent of the loblolly pine plantations less than ten years old were infected. The intensity of infection within the infected plantations was 6 percent; associated mortality was 2 percent. In addition, two infected plantations were detected west of the Plateau.

INTRODUCTION

Comandra blister rust, caused by the fungus, *Cronartium comandrae* Pk., is a stem canker disease of hard pines. The disease is native to the United States, but has been found most frequently in the Western and North Central states. The primary hosts for *C. comandrae* in the west are ponderosa pine, *Pinus ponderosa* Laws, and lodgepole pine, *P. contorta* Dougl. Jack pine, *P. banksiana* Lamb., is the primary host in the North Central states (Mielke, 1961).

Cronartium comandrae is a typical rust fungus, in that it requires an alternate host to complete its life cycle. The alterate hosts for the fungus are herbaceous plants of the genus *Comandra*, known as false toadflax or comandra.

Comandra umbellata (L.) Nutt., subspecies *umbellata* Piehl is the common comandra of the East and South (Piehl, 1965). This small, leafy perennial is widespread in the southeast but is somewhat restricted in local occurrence because of its habitat requirements.

Comandra rust was first found in eastern Tennessee in 1951 on the Bledsoe State Forest. This forest is located approximately in the center of the Cumberland Plateau. The primary hosts affected were ponderosa and loblolly pines. It is believed that *C. comandrae* was introduced into this area on diseased ponderosa pine planting stock shipped in from the West. The results of a preliminary survey made in June, 1966, by the Southeastern Forest Experiment Station and the Division of Forest Pest Control, showed the disease to be widespread on the Cumberland Plateau, south of Highway 70 (Powers, *et al.*, 1967). Infection in loblolly pine plantations, ten years old and younger, ranged from a trace (less than two percent) to more than 90 percent.

METHODS

The comandra rust survey was conducted on state and private forest lands within 19 counties on the Cumberland Plateau. The survey area encompassed approximately 10,000 square miles and involved some 56,000 acres of loblolly pine plantations, ten years old and younger. The sample plantations were selected at random prior to initiating the survey.

The number of plantations sampled per county was determined by the number of loblolly plantations, ten years old and younger, in each county. The sampling within each county was also in proportion to major ownerships such as the Hiwassee Land Company. The sample was modified; whenever possible, in that a minimum of two plantations were sampled per county. Also, in counties with State Forests, at least one plantation was sampled in each forest containing loblolly pine planted since 1957. Approximately five percent of the loblolly pine plantations, ten years old and younger and five acres or more in size, were sampled.

The survey technique recently developed by Roth and Yandle (unpublished) for southern fusiform rust was employed on this survey. The technique involves a random sample, consisting of three rows of trees, within each plantation sampled. The basic technique, however, was modified for use on this survey. Three randomly established transects were substituted for the random rows in the sample plantations without delineable rows. All trees within a six-foot width on the right side of the transect were sampled.

The data was recorded on an individual tree basis. The condition of each tree or probable planting space on the sample rows or transects, was recorded as

healthy, dead, or missing. Each tree was examined for any symptoms and/or signs of *C. comandrae* infection. All stem and branch cankers were recorded separately. Also, dead trees with stem and/or branch cankers and trees dead from other causes were recorded. This provided an estimate of the present mortality due to *C. comandrae* as well as the present infection intensity per plantation. Also, the presence or absence of toadflax and infection on the alternate host was recorded. A sample was collected from an active fruiting canker for microscopic confirmation of the characteristic *C. comandrae* aeciospore from each infected plantation. Finally, each sample plantation was plotted on either TVA 7 - 1/2 minute quadrangle or county road maps (1/2 inch = 1 mile) to permit any re-examinations desired.

RESULTS

The results of this survey showed comandra rust to be present in four counties, all south of Highway 70, on the Cumberland Plateau (Fig. 1). *Cronartium comandrae* infection was widespread in loblolly pine plantations, ten years old and younger, in Bledsoe, Van Buren, Sequatchee and Cumberland counties. Forty percent of the plantations sampled in these four counties were infected (Table 1). Within the infected plantations, six percent of all the trees examined displayed *C. comandrae* stem and/or branch cankers. One-third of these infected trees or two percent of the total trees examined were dead (Table 2).

In addition, the disease was found in two loblolly pine plantations, one each in Franklin and Coffee counties, just west of the Plateau (Fig. 1). Both plantations were approximately 3 years old. Observations in the plantations in Coffee County revealed 5 - 6 infected trees along with an abundance of toadflax in one isolated portion of the stand. Detailed observations were not made in the plantation in Franklin County.

Comandra rust was also detected in two shortleaf pine (*P. echinata* Mill.) stands in Cumberland County. Observations within a 5-to-6-year-old shortleaf pine plantation owned by Hiwassee Land Company revealed severe *C. comandrae* infection and mortality. The other stand was a natural shortleaf pine-hardwood mixture. Only one infected tree, growing in close proximity to a clump of toadflax, was observed in this stand.

Observations on both planted and natural Virginia pine *P. virginiana* Mill.) failed to reveal any indications of comandra rust. In several locations, the Virginia pine was intermixed with infected loblolly pine. Eastern gall rust, caused by *Cronartium quercuum* (Berk.) Miyabe ex. Shirai, branch infections and aecial fruiting, however, were very widespread and sometimes intense on Virginia pine.

Microscopic examinations of aecial fruiting samples collected from all the infected plantations revealed the characteristic pyriform aeciospores of *C. comandrae*.

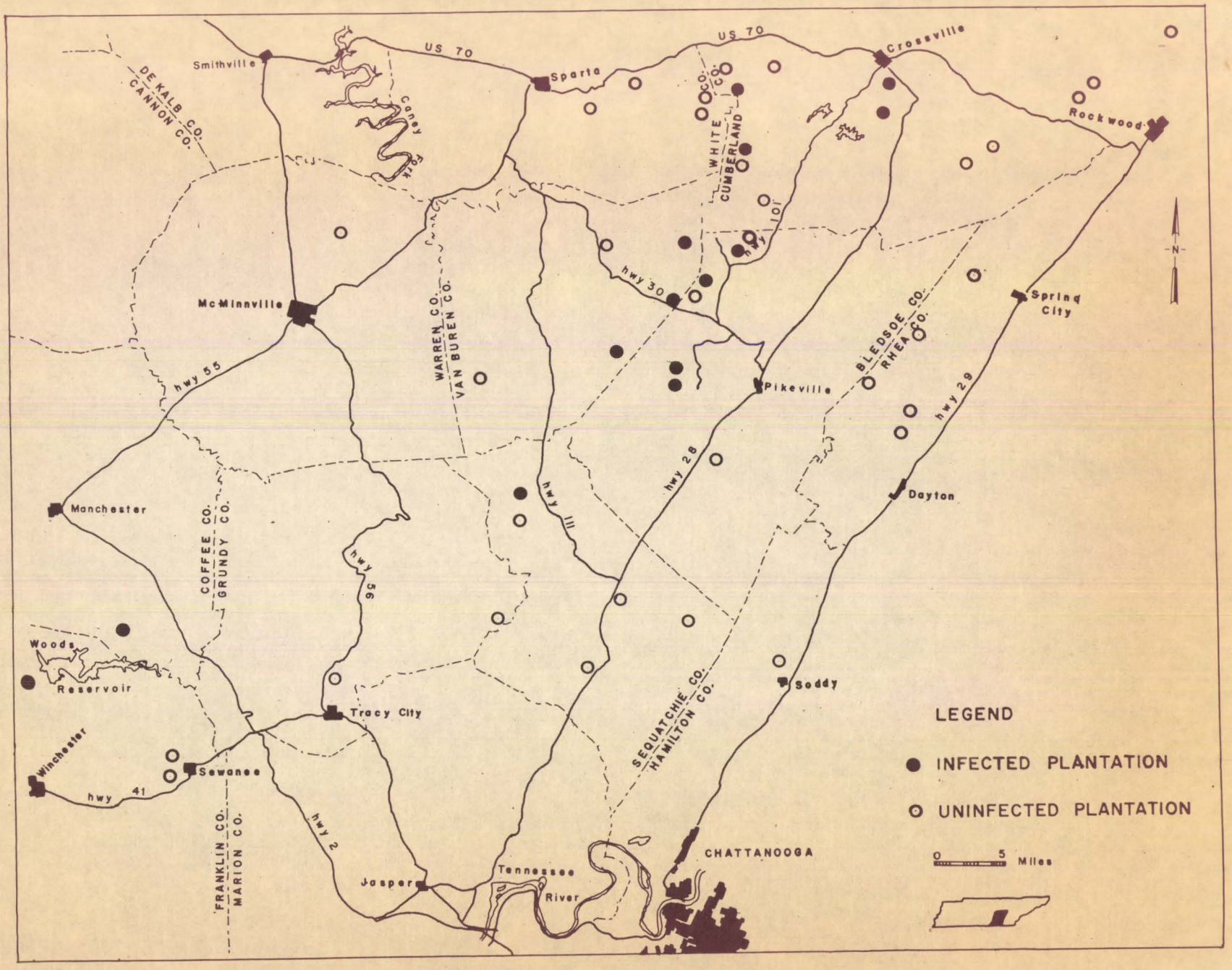


FIG. 1 DISTRIBUTION OF COMANDRA RUST ON THE CUMBERLAND PLATEAU

Table 1 -- Incidence of comandra blister rust in loblolly pine plantations ten years old and younger on the Cumberland Plateau, Tennessee - May 1967.

County	Sample Plantations								
	No. Examined			No. Infected			Percent		
	HLC 1/	Other Private	Total	HLC	Other Private	Total	HLC	Other Private	Average
Cumberland	7	6	13	2	2	4	29	33	31
Sequatchee	3	2	5	1	0	1	33	0	20
Van Buren	0	5	5	0	3	3	0	60	60
Bledsoe	2	5	7	1	3	4	50	60	57
Total	12	18	30	4	8	12	33	44	40

1/ Hiwassee Land Company ownership.

Table 2 -- Intensity of *Cronartium comandrae* infection and associated mortality in infected loblolly pine plantations ten years old and younger on the Cumberland Plateau, Tennessee - 1967.

County	*Cronartium comandrae*					
	Infection - Percent [1]			Mortality - Percent		
	HLC [2]	Other Private	Average	HLC	Other Private	Average
Cumberland	11	3	7	2	1	1
Sequatchee	1	0	1	1	0	1
Van Buren	0	7	7	0	5	5
Bledsoe	1	6	5	0	2	2
Average	9	6	6	1	3	2

1/ Based on the total number of trees examined in the infected plantations.

2/ Hiwassee Land Company ownership.

DISCUSSION

Comandra blister rust is currently widespread and causing localized severe mortality within a four-county area on the Cumberland Plateau. The detection of only six percent *C. comandrae* infection and two percent mortality within the infected plantations is probably highly conservative. The average age of the infected plantations was seven years. A high percentage of missing trees, sometimes as high as 50 percent was observed in several of the infected plantations. Some of this mortality probably resulted from *C. comandrae* infection.

The disease appears to be primarily restricted to the four-county area. Neither *C. comandrae* nor its alternate host were detected in the remaining 15 Plateau counties surveyed. This suggests that the spread of comandra rust in this area has been slow since its initial detection in 1951 on the Bledsoe State Forest.

The most obvious and frequent symptoms and signs associated with *C. comandrae* infections observed on loblolly pine during this survey were stem and branch cankers and the aecial fruiting on active cankers. The aecial fruiting was at a peak during the last week of April, but remained discernible on both stem and branch cankers until the middle of May. The bright, orange-red aecial masses were very conspicuous (Fig. 2). Non-sporulating stem cankers are difficult to detect, however, as a result of the lack of swelling produced in contrast to the hypertrophism associated with fusiform rust stem cankers. In addition, comandra rust branch cankers exhibit a spindle-shaped swelling similar to fusiform rust branch cankers (Fig. 3). The two cankers can be distinguished when fruiting by the color of the aecial masses; bright orange-red for comandra rust and lemon-yellow for fusiform rust. In case of doubt, positive identification can always be obtained from microscopic examinations of the characteristic pyriform *C. comandrae* aeciospores.

Practically all the mortality from *C. comandrae* infection on loblolly pine resulted from stem cankers. This damage results from a girdling action of the fungus and subsequent outright kill or, more commonly, predisposition to stem breakage by wind and other agents (Fig. 4). Stands less than ten years old are most likely to receive severe damage. Branch cankers occurring on older trees, seldom, if ever, reach the main stem.

The feeding of rodents or other small animals was observed in abundance within one loblolly pine plantation in Cumberland County. Over 75 percent of the fruiting cankers had been chewed on. Both teeth and claw marks were visible in the vicinity of the cankers. In many cases, branch cankers, sometimes ten feet above ground, as well as stem cankers, were completely gnawed off. (Fig. 5) Similar rodent feeding has been observed in abundance on fruiting white pine

Fig. 2 - *Cronartium comandrae* aecial fruiting and stem cankers on young loblolly pine. Note the orange-red aecial masses, the absence of swelling associated with these cankers, and the branch cankers (arrow) signifying the probable entry points for the stem cankers.

Fig. 3 - Comandra rust branch cankers on young loblolly pine. Note the swelling associated with these cankers.

Fig. 4 - Wind breakage damage associated with comandra rust stem cankers on loblolly pine saplings.

Fig. 5 - Rodent feeding on comandra rust stem and branch cankers.

Fig. 6 - A clump of false toadflax. Note the small white flower (arrow).

blister rust cankers (Mielke, 1935) and stalactiform rust cankers (Anderson, *et al.*, 1967). In both cases, the rodent feeding was suggested as a major factor in decreasing the disease spread.

False toadflax, *Comandra umbellata* (L.) Nutt, sub-species *umbellata* Piehl, was detected in widely scattered clumps throughout the infected area (Fig. 6). *Cronartium comandrae* uredial fruiting was observed on toadflax leaves in several stands. The plant was scarce in most localized areas, however, and accounted for only a small fraction of the ground vegetation. Toadflax was found most frequently on dry, exposed sites in association with broomsedge and other grasses. In practically all cases, the alternate host was found in close proximity to infected pine. Therefore, the pattern of infection observed within infected plantations seemed to be correlated with the distribution of toadflax. As previously stated, toadflax was not detected outside the infected area. This strongly suggests that the apparent limited distribution of the alternate host in this area may be a major limiting factor in the spread of comandra rust beyond its present range.

A second type of damage was observed extensively in a number of the plantations. A small, burrowing animal, known as a vole, was feeding on roots and girdling young trees at the ground line. Voles are very small rodents and are similar in appearance to field mice. The damage was observed in loblolly, shortleaf, and Virginia pine stands. Over 50 percent of the trees were dead as a result of vole feeding in several stands. The damage seemed to be most severe in the 5-to-10-year-old stands.

RECOMMENDATIONS

1. No practical control methods are available for comandra rust at the present time. All chemical controls tested by research to date have either been ineffective or impractical for forest stands. Research is currently engaged in this problem, however, and controls will be recommended, when available.

2. Landowners should avoid planting either loblolly or shortleaf pine in the infected area. The apparent lack of infection on Virginia pine suggests this species to be more suitable for this area at the present time.

3. A system of spread plots should be established in and around the known infected area to determine the rate of spread and mortality associated with the disease. This should be a cooperative project between the Division of Forest Pest Control and the Tennessee Division of Forestry.

4. A surveillance survey should be made annually, during the period of aecial fruiting, around the periphery of the known infected area. This should be beneficial in detecting the spread of comandra rust and/or the alternate host beyond its known range.

LITERATURE CITED

Anderson, Neil A., David W. French, and Ralph L. Anderson - 1967. The stalactiform rust on jack pine. Jour. of For. Vol. 65, No. 6, pp. 398 - 402.

Mielke, J. L. 1935. Rodents as a factor in reducing aecial sporulation of *Cronartium robicola*. Jour. For. 33 : pp. 994 - 1003.

Mielke, James L. 1961. Comandra Blister Rust. USDA, Forest Pest Leaflet 62, 7 pp.

Piehl, Martin A. 1965. The natural history and taxonomy of comandra (Santalaceae). Mem. Torrey Botan. Club 22 : 1 - 97.

Powers, H. R., G. H. Hepting, and W. A. Stegall, Jr. 1967. Comandra rust on loblolly pine in eastern Tennessee. Plant Dis. Rptr. Vol. 51 : 1, pp. 4-8.

ZONES	FOR STATES OF
Zone 1 Amel E. Landgraf Zone Supervisor P. O. Box 5895 Asheville, North Carolina 28803 Tel. No. AC 704 254-0961, Ext. 625	Kentucky North Carolina South Carolina Tennessee Virginia
Zone 2 William H. Padgett Zone Supervisor P. O. Box 1077 Macon, Georgia 31202 Tel. No. AC 912 746-3531	Alabama Florida Georgia
Zone 3 William M. Ciesla Zone Supervisor 2500 Shreveport Highway Pineville, Louisiana 71360 Tel. No. AC 318 445-6511, Ext. 311	Arkansas Louisiana Mississippi Oklahoma Texas

AREA OFFICE

Russell K. Smith
Assistant Area Director
Peachtree 7th Building
50 Seventh Street, N. E.
Atlanta, Georgia 30323
Tel. No. AC 404 526-5189